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# NIACIN-TRYPTOPHAN REQUIREMENTS OF MAN

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Since the time of Goldberger's classical experiments in the production of pellagra in man, there have been numerous reports of successful attempts to produce pellagra experimentally, but it was not until recent years that the quantitation of the dietary constituents used in such experiments became sufficiently trustworthy to merit acceptance in estimations of dietary allowances. The 1958 revision of the Recommended Dietary Allowances of the National Research Council no longer speaks of niacin requirements *per se* but of niacin in milligram-equivalents.

The first attempt to quantitate the relationship between tryptophan and niacin was reported in 1946 by Krehl *et al*, who showed that, in rats, 50 mg. tryptophan could replace 1 mg. niacin in 100 gm. of diet. At about the same time, the recalculations of the niacin content of pellagra-producing and pellagra-preventing diets used by earlier investigators were published. These tables showed that the milk diets used by Goldberger to prevent pellagra provided 5 mg. niacin per day and the corn product diets which produced pellagra contained about 7 mg. per day. The significance of these observations was not recognized until later.

Although the quantitative relationship between tryptophan and niacin had been demonstrated in rat experiments there was no way of knowing that human requirements were similar. It was evident that the information sought for humans would have to come from man himself.

### Human Needs Studied

To resolve the question, the Food and Nutrition Board of the National Research Council agreed in 1950 that the third Elgin project should be concerned with the niacin requirements of adult men. A study was made using a basal diet low in niacin and tryptophan. At the same time, Goldsmith's group in New Orleans was studying the niacin requirements of adult women, using diets containing slightly less niacin-tryptophan than the basal diet in our project. As it turned out, symptoms of pellagra were obtained in the New Orleans study, but no such symptoms were noted in the Elgin study.

From our studies, the amount of tryptophan chosen to be equivalent to 1 mg. niacin was 60 mg. This estimate was based on a comparison of the amounts of niacin and tryptophan ingested with the average amounts of $N^1$-methylnicotinamide excreted in the urine of the test subjects. It is unreasonable to assume the existence of an inflexible relationship between tryptophan and niacin consumption which could be maintained through all genetic and dietary variations. On the other hand, we cannot long go on without using some estimate of tryptophan-niacin relationships.

Confirmation of the approximate 60 to 1 ratio was obtained from the data of Goldsmith *et al*. Recently, Wertz, *et al* reported that the amount of tryptophan equivalent to 1 mg. niacin varied from 45 to 69 mg. in four female subjects.

### Calculating Niacin-Equivalents

Having chosen 60 mg. tryptophan as the dietary equivalent of 1 mg. niacin, we may see how results obtained from the use of this relationship affect the calculations of food values. To make exact calculations of niacin equivalents, it is necessary to refer to existing tables of the tryptophan content of various proteins.

From such tables it will be noted that corn meal proteins contain about 0.7 percent tryptophan; wheat flour and fish proteins about 0.9 percent; muscle and seed proteins about 1 percent; and milk and egg proteins about 1.3 percent tryptophan.

*Dr. Horwitt*

A diet which provides 60 gm. mixed protein provides about 600 mg. tryptophan or 10 niacin-equivalents from tryptophan alone. The niacin content, determined in milligrams by standardized procedures, is then added to give the total milligram-equivalent to niacin.

### Niacin-Equivalent Allowance

Since 8.8 mg. niacin-equivalents seem to be the amount needed to barely prevent pellagra in individuals consuming 2000 calories or less, it has been suggested that 4.4 mg. per 1000 calories be considered as a basic allotment, to which a safety factor of 50 percent has been added by the 1958 revision of the Recommended Dietary Allowances to provide a minimum allowance. This works out to be 6.6 mg. per 1000 calories with a minimum of 13 mg. per 2000 calories or less. With so large a decrease from previous allowances, it seems logical to modify the strict interpretation of the new allowance per-calories-consumed so that adults of 58 kg. do not receive less than 17 mg. niacin-equivalents per day, an amount which is easily provided by a diet containing only 7 mg. niacin and 60 gm. mixed protein.

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# Glances AT NUTRITION RESEARCH

**Effects of early dietary inadequacies and excesses in childhood and adult life need to be thoroughly investigated in relationship to health and chronic illness in aging men and women.**

**Weight reduction in middle age**—Loss of 20 to 60 pounds excess body fat does not assure full regression of signs of illness in obese middle-aged men and women as measured by reduction of blood pressure, serum cholesterol levels and symptoms of chronic illness. Mean daily intakes of 1815 calories by obese women and 2600 calories by obese men are not far different from calorie intakes of non-obese individuals in many areas. These facts were revealed by study of 400 obese subjects, 40 to 60 years of age, 25 percent or more over desired weight when offered diet therapy featuring reduced intakes of calories and fat.

—*J. Am. Diet. Assn. 35:22 (Jan.) 1959.*

**Low-calcium intakes inadequate**—Daily intakes of 175 to 253 mg. of calcium do not appear adequate nor desirable for young men. Negative calcium balance persisted after 95 days on such intakes among 6 young men who previously consumed 1250 to 2000 mg. calcium daily; and among 4 of 5 young men who previously consumed 350 to 750 mg. calcium daily. While there was a trend toward increased efficiency of calcium retention during the test period, retention was not sufficient for equilibrium except in one very small man whose diet had always been low in calcium. The amount of calcium stored in bone reflected the amount present in the accustomed diet of the subjects. Bones were less dense, less well calcified, in those subjects whose calcium intakes were low.

—*J. Am. Diet. Assn. 35:23 (Jan.) 1959.*

**Calcium-phosphorus interdependency**—Seven young men continuously lost body phosphorus during 95 days on a diet low in calcium and moderate in phosphorus content. The diet provided 232 mg. calcium and 1063 mg. phosphorus daily. Meat was eaten twice daily. No milk or cheese were used. The only young man not in negative balance after 95 days previously had been on a high calcium diet. The authors suggest increasing calcium intake as a means of improving phosphorus retention. (This means use of milk and cheese. The test diets contained about the daily level of calcium provided by foods other than milk and its products in our American food pattern.)

—*J. Am. Diet. Assn. 35:31 (Jan.) 1959.*

**Retentions in underfed girls**—Low positive balances for calcium, phosphorus and nitrogen were observed in 5 day studies of 10 undernourished Indian girls aged 9 to 11 years. Mean daily retentions were: 28.5 and 93.3 mg. calcium on daily intakes of 285.2 and 380.1 mg.; 83.4 and 106.6 mg. phosphorus on daily intakes of 546.8 and 562.4 mg.; and 0.786 and 0.941 gm. nitrogen on daily intakes of 3.70 and 5.30 gm. (The girls were 3 to 10 inches shorter and 17 to 42 pounds lighter than girls in the United States for whom daily retentions of 400 to 500 mg. of calcium have been estimated as desirable.)*

—*Br. J. Nut. 12:429 (No. 4) 1958.*

* *Hathaway, M. L. Heights and weights of children and youth in the United States. Page 45. Home Econ. Res. Report No. 2. U.S.D.A., Washington, D.C. (Oct.) 1957.*

* *Martin, E. A. Roberts' Nutrition Work With Children. Page 233. Chicago: Univ. of Chicago Press, 1954.*

## TIMELY TOPICS

### Dr. Horwitt

Dr. Horwitt has been closely associated with the long-term human metabolic research programs sponsored by the Food and Research Council, National Academy of Sciences, in his work at the Elgin State Hospital, Elgin, Illinois. Arriving there during 1937, Dr. Horwitt intended only to stay for a 6-month project. He is still there, and as Director of the Biochemical Research Laboratory. He also serves as Associate Professor of Biological Chemistry for the University of Illinois, College of Medicine, Chicago.

This busy researcher, teacher, and author modestly states, as his only claim to fame, that he was the last student to receive his Ph.D. degree in Biochemistry under the renowned Dr. Mendel at Yale University. Dr. Horwitt and his staff are now doing human metabolic studies on tocopherols.

A full report of Dr. Horwitt's metabolic studies of niacin-tryptophan relationships in man can be found in the Journal of Nutrition, Vol. 60, Supplement 1, October 1956.

### Designs for Retirement

The University of Michigan's *12th Annual Conference on Aging* will be held June 22-24, at Ann Arbor. The theme of "Designs for Retirement" will be covered in 5 major sections: Retirement for health, retirement housing, retirement financing, preparation for retirement, and use of time after retirement. For further information you may write to Dr. Wilma Donahue, Institute of Gerontology, 1510 Rockman Bldg., Ann Arbor, Michigan.

## IN SEARCH OF ANSWERS

*Bertha Bishov, Home Economics Consultant*
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Unlike the nation's babies, whose nutritional needs have been continuously studied, research on the dietary needs of older people has for the most part been a matter of educated guesswork. Now medical authorities are starting to get the backing they need. Both industry and government are pushing ahead on geriatric food research.

Independent laboratories are working to fill in some of the fundamental background with nutrition research on aging rats and dogs. A handful of hospitals and medical centers have started experiments with controlled groups of patients.

Geriatric food researchers believe that malnutrition is a basic factor in speeding up the process of structural changes in body cells. Malnutrition doesn't necessarily mean a lack of food. It has a broader meaning, covering the wrong kind of food, or the wrong proportions of various foods, or even too much food.

While those over 65 may be eating what for other age groups might be an adequate diet, this same food may not give the older adults what *they* need. The one thing they don't need is more calories!

Also, highly important from the nutritional angle is the apparent increased need for protein. Scientific evaluation of how great this need really is has only been crudely recorded with human test subjects. But studies on rats indicate that protein intake may be involved with the so-called diseases of old age, such as arthritis, rheumatism and others.

Many older people eat high-quality protein foods only occasionally. This is not enough—for the body needs protein foods every day. The reasons for this low intake may have more to do with sociology, economics, loss of appetite, or emotions than with any dietary study. Meat, fish, egg, poultry, cheese, beans and nuts are on the whole more expensive than other types of food. They may also be hard to chew, or more difficult to prepare.

Poor dietary habits throughout life or a real lack of nutrition information may also play a part in the low intake of essential nutrients for the aged. A survey made of the use of milk by older people living in Connecticut reported that many of the 65-year-olds didn't know that milk was a protein food of high biological value. They thought of milk as "just another beverage."

Calcium, needed to keep bone tissues healthy, is found in milk, cheese, beans, almonds, and in greens. Whether people need more calcium as they get older, and how much of it elderly people should get beyond the recommended quantities for adults, are still unanswered questions. Studies on rats indicate that any prolonged deficiency in calcium—below certain minimums—results in bone deterioration that, even after an improved diet is established, takes a toll in later life.

The amount of iron a senior citizen should get in his daily diet is another challenging problem. The minimum requirement for the over-65 group is not yet fully determined.

A three-year rat nutrition study under Dr. Clive McCay at Cornell University offers some valuable evidence on longevity effects of different diets. These studies did not show any significant differences from feeding different types of fat. It did find that feeding a high level of butterfat (27 percent of the calories) did not cause any abnormal conditions which shortened life. So it would seem that factors other than fat in the diet were important in sustaining a long life.

We won't get all our answers in a hurry. Results from animal studies can't be correlated precisely to human nutritional requirements.

There are even greater difficulties in research with human patients. Scientists need many months for the simplest nutritional experiments and years for more complex problems. They need groups of oldsters numbering in the hundreds—and these can't be bedfast, must live in a carefully controlled environment, be available for biochemical and other tests. Various groups have been suggested as test subjects: older groups in prisons, mental hospitals, veterans' homes—but except on a very limited scale, no sizable numbers have yet been made available to researchers.

Until the National Research Council makes recommendations for daily dietary requirements for those 65 years and older, there is a safe and sane approach to food for this age group. If they follow the nutrient levels now established for adults of 45 years of age, but with a reduction in calories, particularly in the form of sweets and fats, we can tentatively assume that they will be well-nourished.

## NUTRITION CLUB AT WORK IN A NEW YORK COMMUNITY CENTER

*By Jean Trisko, Graduate Student, New York School of Social Work, and David Richards, Director of Public Information, National Committee on the Aging*

Every Wednesday night, a group of students meet in New York's Hodson Community Center for an hour's instruction on the vital subject of diet and its relation to health. The students are all between 60 and 90 years old. They belong to the Center's nutrition group which has been spreading information about food and health among the older people in the neighborhood since 1953.

Here is a typical program in action. Miss Joan Gershun, a nutritionist from the local office of the Department of Public Health, describes some of the foods which are both economical to buy and nutritious to eat. Her words are illustrated with a display of pictures. She throws out questions and a group discussion follows.

At the next meeting, Miss Gershun conducts a quiz-type program, again encouraging participation by the whole group. Popular food fallacies are exposed. She points out, for instance, that brown eggs have exactly the same food value as white eggs.

She may ask these questions: "Are canned foods as nutritious as fresh produce?" or "Is toast less fattening than bread?" or "Are vegetable juices better for you than the whole vegetable?"—and she follows up with the

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—that more than 40,000,000 people, or about 30 percent of our total population, is now over 45 years old?

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—that last year Wisconsin dairy plants used nearly 5 billion pounds of milk in making butter—more than they used in making American cheese?

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—that every one of the 800 to 1,000 strands of silk on a corncob represents the possible development of one kernel of corn?

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—that through the use of improved tissue culture methods, scientists can now observe where fatty materials enter cells grown from human arteries?

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—that our national per capita consumption of cottage cheese is less than 5 pounds per year, but that California uses 12 pounds per person each year?

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—that in view of the increasing use of fluid skim milk or reconstituted nonfat dry milk the National Research Council has approved the restoration of vitamin A to these products to the average year-round level present in whole milk?

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—that joining the long list of diabetic foods is a new artificially sweetened, vanilla or coffee-flavored ice cream made especially for diabetics and those on restricted sugar diets?

# THINGS YOU'LL LIKE TO READ

**The Care of the Geriatric Patient**—E. V. Cowdry, Editor. C. V. Mosby Co., St. Louis. 1958. $8.00.

Written primarily for physicians, this book presents a syllabus of the latest techniques and research findings on the treatment of the geriatric patient as a whole person, including the medical, psychological, nutritional and nursing aspects of the ill. Special chapters cover home care, homes for the aged, nursing homes, rehabilitation and community organizations for older people.

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**Simplified Diet Manual with Meal Patterns**—Ed. by Nutrition Service of the Iowa Dept. of Health and Iowa Dietetic Assoc., Iowa State College Press, Ames, Iowa. 1958. $1.95.

Physicians, dietitians, nutritionists or public health personnel will find this compilation useful. It is based on authoritative material reviewed by a committee of the Iowa Dietetic Association and has been tested in the ten hospitals found listed in the acknowledgments.

The book includes "How Food Groups Contribute Nutrients," the "General Diet and Modified Diets," giving those most frequently used. An interesting addition is the "Diet for Older People."

Most of the diets are planned to "provide the level of daily nutrients recommended for the average person by the National Research Council." Some of the diets are more liberal and attractive than diets usually found in hospitals.

The dietary explanations are practical and require little additional instruction with the exception of the Diabetic Diets. Single diet leaflets are available to physicians for use with the patient.

## NUTRITION CLUB AT WORK IN A NEW YORK COMMUNITY CENTER

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correct answers if they are not forthcoming.

The nutrition group now has over 50 members, and it has a varied program of activities. Films on food preparation and family nutrition are shown. Favorite recipes are compared and exchanged.

One of the most significant programs was a luncheon given by the nutrition group for the entire membership of the Center. Committees were set up to plan for the event. All members of the group were involved in the project. They made place mats, decorated the lounge in gay colors, folded napkins, set the tables, or hung nutrition posters at the entrance. A National Dairy Council representative set up an attractive food display based on the four food groups from the "Guide to Good Eating."

To add to all the excitement, photographers from the local newspapers arrived to take pictures. The ladies and gentlemen were dressed up for the occasion.

The National Committee on Aging is conducting a study of standards of centers and club programs for older people. The Hodson Community Center has provided material for this project.

The Committee depends upon a health consultant for guidance in their programs with older people. A 10-year study by another group, among elderly overweight patients reported a doubling at the end of this decade in the incidence of cardio-vascular-renal diseases; a four-fold increase in incidence of high blood pressure and gall bladder disease. Almost forty percent of the obese patients developed varicose veins and fifty percent were afflicted with hypertrophic arthritis. Overweight is a serious problem for the aged.

Dr. Alexander W. Kruger, the Committee's Health Consultant, has this to say about nutrition for older people: "Medical studies over the years seem to indicate that elderly individuals who are treated for nutritional deficiencies, obesity, and disturbance in body metabolism may add years to their lives."

Any organization serving the needs of senior citizens, may contact the National Committee on the Aging, located at 345 East 46th Street, New York 17, New York.